



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/577,323	12/06/2006	Kazuaki Katagiri	290089US0X PCT	4963
22850	7590	01/23/2009		
OBLON, SPIVAK, MCCLELLAND MAIER & NEUSTADT, P.C.			EXAMINER	
1940 DUKE STREET			SAHA, BIJAY S	
ALEXANDRIA, VA 22314			ART UNIT	PAPER NUMBER
			4181	
NOTIFICATION DATE	DELIVERY MODE			
01/23/2009	ELECTRONIC			

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@oblon.com  
oblonpat@oblon.com  
jgardner@oblon.com

<b>Office Action Summary</b>	<b>Application No.</b> 10/577,323	<b>Applicant(s)</b> KATAGIRI ET AL.
	<b>Examiner</b> BIJAY SAHA	<b>Art Unit</b> 4181

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If no period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) Responsive to communication(s) filed on \_\_\_\_.
- 2a) This action is FINAL.      2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) Claim(s) 1-12 is/are pending in the application.
  - 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) Claim(s) \_\_\_\_ is/are allowed.
- 6) Claim(s) 1-12 is/are rejected.
- 7) Claim(s) \_\_\_\_ is/are objected to.
- 8) Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on 28 April 2006 is/are: a) accepted or b) objected to by the Examiner.
 

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) All    b) Some \* c) None of:
    1. Certified copies of the priority documents have been received.
    2. Certified copies of the priority documents have been received in Application No. \_\_\_\_.
    3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO/SB/08)
 

Paper No(s)/Mail Date 7/21/2006
- 4) Interview Summary (PTO-413)
 

Paper No(s)/Mail Date. \_\_\_\_.
- 5) Notice of Informal Patent Application
- 6) Other: \_\_\_\_.

**DETAILED ACTION**

***Status of Application***

The claims 1-12 are pending and presented for the examination.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

**Claims 5, 6, 7, 8 and 9-12** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding **claims 5, 6, 7 and 8**, claims are drawn to the limitation of (a) a process of treating the knead-dispersed material by discharge plasma and (b) a process of sintering the resultant dispersed material by discharge plasma. It appears that there are two separate process steps involved; however, per the applicant disclosure "process of sintering (treating) by discharge plasma" (page 3 para 0043), treating is same as sintering. Examiner maintains that the process of treating by discharge plasma is same as sintering by discharge plasma since "treating" a green body by discharge plasma is expected to produce "sintering" within the green body. The knead-dispersed material is a green body. Treating a green body by discharge plasma causes sintering.

Examiner interprets that both steps (a) and (b) are drawn to the same process of sintering.

**Claim 9** is indefinite as to "high" and "low".

The terms "low temperature", "low pressure" and "high temperature" in **claim 9** are relative terms which render the claim indefinite. The terms "low" and "high" are not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

The other **claims 10-12** are indefinite because they depend on indefinite claims.

Claims **2-8** are indefinite as to the way claims are drafted. To the examiner, it is unclear as to the metes and bound of the claim protection sought. It would appear that the claims are defining multiple process steps; however, the individual steps are not clearly delineated in the claims. Examiner suggests that the claims be defined using characters (a), (b), (c), (d), etc. to distinctly clarify and separate the process steps.

#### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

**Claims 1, 9, 10, 11 and 12** are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoichi et al JP10088256 (hereafter JP '256) in view of Shotaro et al JP2000128648 (hereafter JP '648).

Regarding **claim 1**, JP '256 teaches a method of producing a carbon nanotube reinforced composite (Title) comprising a process of kneading and dispersing a metal

powder (para 0013) and carbon nanotubes (example 1 para 0014) in an amount of 5 to 30 volume % (claims 1 and 2) (equivalent 10 wt% or less). JP '256 refers to the teaching that the composite is used in aerospace industries; thus, it is the examiner's position that this composite must be made by a sintering technique in order to obtain a strength requirement by this application.

JP '256 does not explicitly teach the process of sintering by discharge plasma.

JP '648 teaches that sintering can be accomplished by high temperature which is produced by discharge plasma (Claims 1, 2, Table 1 and 2). The discharge plasma is utilized to produce high temperature that causes sintering.

At the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching). The suggestion or motivation for doing so would have been to make a homogeneous compact body that has low defects. A green body is sintered by the application of a suitable high temperature which is the fundamental requirement of sintering. A suitable high temperature can be produced either by conventional process where a green body is placed in a furnace; or alternatively, high temperature is produced by discharge plasma. Discharge plasma sintering of a green body produces homogeneous finished product without a sintering defect (JP '648, para 0099).

Regarding **claim 9**, JP '648 teaches the application of plasma from a low range of pressure of 0.1 Tl/cm (low) to 20 Tl/cm (high) pressure (para 0032). Sintering is produced under both low and high pressures due to plasma discharge. Degree of sintering is dependent upon the density of the green body (JP '648 para 0010-0014). A low pressure green body is not compact enough to completely remove the sintering defects; however, low pressure plasma discharge would remove residual gases which is a prelude of high pressure discharge plasma sintering producing high quality product. In view of this, one skilled in the art would have clearly understood that if a low pressure sintering is initially used, and it was desired to obtain a high density product (depending on its application), the use of high pressure sintering as a subsequent step would be apparent.

Regarding **claim 10**, JP '648 teaches the particle size of granular material in the range of 0.1 micrometer to 200 micrometer (claim 12) which includes the ceramic powder range of 10 micron or less and metal particle range of 200 micrometer or less.

Regarding **claim 11**, JP '648 teaches use of alumina (para 0073).

Regarding **claim 12**, JP '648 teaches aluminum, copper and stainless steel (para 0025).

**Claim 2** is rejected under 35 U.S.C. 103(a) as being unpatentable over JP '256 in view of JP '648 and Jung et al (App Surf Sc, 193, 2002, 129-137) (hereafter Jung)

Regarding **claim 2**, teachings of JP '256 in view of JP '648 have been delineated above in the 103 rejection of claim 1.

JP '256 does not explicitly teach the following:

(1) the application of discharge plasma to the carbon nanotube prior to sintering with the mixture of the metal powder and carbon nanotubes,

(2) plasma sintering of the mixture of the metal powder and the carbon nanotubes.

Teachings of JP '648 have been delineated above in claim 1 rejection.

Jung teaches that the electrical properties of carbon nanotubes (Figures 8, 9 and 10) can be altered by plasma discharge.

With respect to (1), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) and treating the carbon nanotubes by plasma (Jung teaching). The suggestion or motivation for doing this preliminary treatment is to alter the surface electrical properties of carbon nanotubes so that end composite material containing the carbon nanotubes have a range of electrical properties. Since carbon nanotubes are part of the composite material, the properties of the carbon nanotubes determine the properties of the composite material as well.

With respect to (2), the suggestion or motivation for doing so would have been to make a homogeneous compact body that has low defects. A green body is sintered by the application of suitable high temperature which is the fundamental requirement of sintering. A suitable high temperature can be produced either by conventional process where a green body is placed in a furnace; or alternatively, high temperature is produced by discharge plasma. Discharge plasma sintering of a green body produces homogeneous finished product without a sintering defect (JP '648, para 0099).

Combining (1) and (2), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching) by treating the carbon nanotube by plasma discharge (Jung teaching). Discharge plasma sintering of a green body produces homogeneous finished product without a sintering defect (JP '648, para 0099) with a range of electrical properties.

**Claims 3** is rejected under 35 U.S.C. 103(a) as being unpatentable over JP '256 in view of JP '648 and Reddy et al (Jour Mat Sc, 37, 2002 pages 929-934) (hereafter Reddy).

Regarding **claim 3**, teachings of JP '256 in view of JP '648 have been delineated above in the 103 rejection of claim 1.

JP '256 does not explicitly teach the following:

- (1) the wet dispersing of the mixture using a dispersing agent,
- (2) plasma sintering of the mixture of the metal powder and the carbon nanotubes.

Teachings of JP '648 have been delineated above in claim 1 rejection.

Reddy teaches a method of nano powder wet-dispersing using a dispersing agent (Table II page 930).

With respect to (1), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) by dispersing the solids in a wet stage using a surfactant (Reddy teaching). The suggestion or motivation for doing so would have been to make a homogeneous liquid dispersion that would make a homogeneous green body which would lead to compact body that has low defects. A combination of surfactant and wet medium allows enhanced mobility of nanosize particles. Enhanced mobility produces homogeneous distribution of chemical species that produces a uniform green body.

With respect to (2), the suggestion or motivation for doing so would have been to make a homogeneous compact body that has low sintering defects. A green body is sintered by the application of suitable high temperature, which is the fundamental requirement of sintering. A suitable high temperature can be produced either by conventional process where a green body is placed in a furnace. Alternatively, high temperature is produced by discharge plasma. Discharge plasma sintering of a green

body produces homogeneous finished product without a sintering defect ( JP '648, para 0099).

Combining (1) and (2), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching) by dispersing the solids in a wet stage using a surfactant (Reddy teaching). The suggestion or motivation for doing so would have been to make a homogeneous liquid dispersion with surfactant that would lead to a homogeneous green body which would lead to compact body that has low defects. Discharge plasma sintering of a green body produces homogeneous finished product without a sintering defect ( JP '648, para 0099).

**Claim 4** is rejected under 35 U.S.C. 103(a) as being unpatentable over JP '256 in view of JP '648, Jung and Reddy.

Regarding **claim 4**, teachings of JP '256 in view of JP '648 have been delineated above in the 103 rejection of claim 1.

JP '256 does not explicitly teach the following:

(1) the application of discharge plasma to the carbon nanotube prior to sintering with the mixture of the metal powder and carbon nanotubes,

(2) the wet dispersing of the mixture using a dispersing agent,

(3) plasma sintering of the mixture of the metal powder and the carbon nanotubes.

Teachings of JP '648 have been delineated above in claim 1 rejection.

Teaching of Jung has been delineated in the 103 rejection of claim 2 above.

Teaching of Reddy have been delineated in the 103 rejection of claim 3 above.

With respect to (1), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) and treating the carbon nanotubes by plasma (Jung teaching). The suggestion or motivation for doing this preliminary treatment is to alter the surface electrical properties of carbon nanotubes so that end composite material containing the carbon nanotubes have a range of electrical properties. Since carbon nanotubes are part of the composite material, the properties of the carbon nanotubes determine the properties of the composite material as well.

With respect to (2), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching) by dispersing the solids in a wet stage using a surfactant (Reddy teaching). The suggestion or motivation for doing so would have been to make a homogeneous liquid dispersion with surfactant that would lead to a homogeneous green body which would lead to compact body that has low defects. A combination of surfactant and wet medium allows

enhanced mobility of nanosize particles. Enhanced mobility produces homogeneous distribution of chemical species that produces a uniform green body.

With respect to (3), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching). The suggestion or motivation for doing so would have been to make a homogeneous compact body that has low defects. A green body is sintered by the application of suitable high temperature which is the fundamental requirement of sintering. A suitable high temperature can be produced either by conventional process where a green body is placed in a furnace, or alternatively, high temperature is produced by discharge plasma. Discharge plasma sintering of a green body produces homogeneous finished product without a sintering defect (JP '648, para 0099).

Combining (1) and (2) and (3), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching) by dispersing the solids in a wet stage using a surfactant (Reddy teaching) and treating the carbon nanotube by plasma discharge (Jung teaching). The suggestion or motivation for doing so would have been to make a homogeneous liquid dispersion with surfactant that would lead to a homogeneous green body which would lead to compact body that has low defects. A combination of surfactant and wet medium allows

enhanced mobility of nanosize particles while plasma treatment of carbon nanotube alters the surface electrical properties of carbon nanotubes so that end composite material containing the carbon nanotubes have a range of electrical properties. Discharge plasma sintering of a green body produces homogeneous finished product without a sintering defect ( JP '648, para 0099).

**Claims 5** is rejected under 35 U.S.C. 103(a) as being unpatentable over JP '256 in view of JP '648.

Regarding **claim 5**, teachings of JP '256 have been delineated above in the 103 rejection of claim 1.

JP '256 does not explicitly teach the following:

(1) a process of treating the kneaded dispersed material with plasma discharge,  
(2) plasma sintering of the mixture of the metal powder and the carbon nanotubes.

JP '648 teaches process of sintering by discharge plasma (Claims 1, 2).

With respect to (1), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching). The suggestion or motivation for doing so would have been to make a homogeneous compact body that has low defects. A green body is sintered by the application of suitable high temperature which is the fundamental requirement of sintering. A suitable

high temperature can be produced either by conventional process where a green body is placed in a furnace, or alternatively, high temperature is produced by discharge plasma. Discharge plasma sintering of a green body produces homogeneous finished product without a sintering defect ( JP '648, para 0099).

With respect to (2), the process of sintering is caused by discharge plasma. Examiner interprets that the process of treating the knead-dispersed material by discharge plasma is equivalent to sintering the knead-dispersed material. Process of sintering the resultant dispersed material by discharge plasma is the extension sintering of the knead-dispersed material.

Combining (1) and (2), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching). The suggestion or motivation for doing so would have been to make a homogeneous compact product without a sintering defect ( JP '648, para 0099).

**Claims 6** is rejected under 35 U.S.C. 103(a) as being unpatentable over JP '256 in view of JP '648 and Jung.

Regarding **claim 6**, teachings of JP '256 have been delineated above in the 103 rejection of claim 1.

JP '256 does not explicitly teach the following:

(1) the application of discharge plasma to the carbon nanotube prior to sintering with the mixture of the metal powder and carbon nanotubes,

(2) a process of treating the kneaded dispersed material with plasma discharge,

(3) plasma sintering of the mixture of the metal powder and the carbon nanotubes

Teachings of JP '648 have been delineated above in claim 1 rejection.

Jung teaches the alteration of electrical properties of carbon nanotubes (Figures 8, 9 and 10).

With respect (1), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) and treating the carbon nanotubes by plasma (Jung teaching). The suggestion or motivation for doing this preliminary treatment is to alter the surface electrical properties of carbon nanotubes so that end composite material containing the carbon nanotubes have a range of electrical properties. Since carbon nanotubes are part of the composite material, the properties of the carbon nanotubes determine the properties of the composite material as well.

With respect (2), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching). The suggestion or motivation for doing so would have been to make a homogeneous

compact body that has low defects. A green body is sintered by the application of suitable high temperature which is the fundamental requirement of sintering. A suitable high temperature can be produced either by conventional process where a green body is placed in a furnace, or alternatively, high temperature is produced by discharge plasma. Discharge plasma sintering of a green body produces homogeneous finished product without a sintering defect (JP '648, para 0099).

With respect to (3), the process of sintering is caused by discharge plasma. Examiner interprets that the process of treating the knead-dispersed material by discharge plasma is equivalent to sintering the knead-dispersed material. Process of sintering the resultant dispersed material by discharge plasma is the extension sintering of the knead-dispersed material.

Combining (1), (2) and (3), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching). The suggestion or motivation for doing so would have been to make a homogeneous compact body without a sintering defect and alter the surface electrical properties of carbon nanotubes so that end composite material containing the carbon nanotubes have a range of electrical properties.

**Claims 7** is rejected under 35 U.S.C. 103(a) as being unpatentable over JP '256 in view of JP '648 and Reddy.

Regarding **claim 7**, teachings of JP '256 have been delineated above in the 103 rejection of claim 1.

JP '256 does not explicitly teach the following:

- (1) the wet dispersing of the mixture using a dispersing agent,
- (2) a process of treating the kneaded dispersed material with plasma discharge,
- (3) plasma sintering of the mixture of the metal powder and the carbon nanotubes.

Teachings of JP '648 have been delineated above in claim 1 rejection

Reddy teaches a method of nano powder wet-dispersing using a dispersing agent (Table II page 930).

With respect (1), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) by dispersing the solids in a wet stage using a surfactant (Reddy teaching). The suggestion or motivation for doing so would have been to make a homogeneous liquid dispersion that would make a homogeneous green body which would lead to compact body that has low defects. A combination of surfactant and wet medium allows

enhanced mobility of nanosize particles. Enhanced mobility produces homogeneous distribution of chemical species that produces uniform green body.

With respect to (2), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching). The suggestion or motivation for doing so would have been to make a homogeneous compact body that has low defects. A green body is sintered by the application of suitable high temperature which is the fundamental requirement of sintering. A suitable high temperature can be produced either by conventional process where a green body is placed in a furnace, or alternatively, high temperature is produced by discharge plasma. Discharge plasma sintering of a green body produces homogeneous finished product without a sintering defect (JP '648, para 0099).

With respect (3), the process of sintering is caused by discharge plasma. Examiner interprets that the process of treating the knead-dispersed material by discharge plasma is equivalent to sintering the knead-dispersed material. Process of sintering the resultant dispersed material by discharge plasma is the extension sintering of the knead-dispersed material.

Combining (1), (2) and (3), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP

'256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching) by dispersing the solids in a wet stage using a surfactant (Reddy teaching). The suggestion or motivation for doing so would have been to make a homogeneous liquid dispersion that would make a homogeneous green body which would lead to compact body that has low defects. A combination of surfactant and wet medium allows enhanced mobility of nanosize particles. Enhanced mobility produces homogeneous distribution of chemical species. Discharge plasma sintering of a green body produces homogeneous finished product without a sintering defect ( JP '648, para 0099).

**Claim 8** is rejected under 35 U.S.C. 103(a) as being unpatentable over JP '256 in view of JP '648, Jung and Reddy.

Regarding **claim 8**, teachings of JP '256 have been delineated above in the 103 rejection of claim 1.

JP '256 does not explicitly teach the following:

- (1) the application of discharge plasma to the carbon nanotube prior to sintering with the mixture of the metal powder and carbon nanotubes,
- (2) the wet dispersing of the mixture using a dispersing agent,
- (3) a process of treating the kneaded dispersed material with plasma discharge,
- (4) plasma sintering of the mixture of the metal powder and the carbon nanotubes.

Teachings of JP '648 have been delineated above in claim 1 rejection.

Teaching of Jung has been delineated in the 103 rejection of claim 2 above.

Teaching of Reddy have been delineated in the 103 rejection of claim 3 above.

With respect to (1), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) and treating the carbon nanotubes by plasma (Jung teaching). The suggestion or motivation for doing this preliminary treatment is to alter the surface electrical properties of carbon nanotubes so that end composite material containing the carbon nanotubes have a range of electrical properties. Since carbon nanotubes are part of the composite material, the properties of the carbon nanotubes determine the properties of the composite material as well.

With respect to (2), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) by dispersing the solids in a wet stage using a surfactant (Reddy teaching). The suggestion or motivation for doing so would have been to make a homogeneous liquid dispersion that would make a homogeneous green body which would lead to compact body that has low defects. A combination of surfactant and wet medium allows enhanced mobility of nanosize particles. Enhanced mobility produces homogeneous distribution of chemical species that produces uniform green body.

With respect to (3), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching). The suggestion or motivation for doing so would have been to make a homogeneous compact body that has low defects. A green body is sintered by the application of suitable high temperature which is the fundamental requirement of sintering. A suitable high temperature can be produced either by conventional process where a green body is placed in a furnace, or alternatively, high temperature is produced by discharge plasma. Discharge plasma sintering of a green body produces homogeneous finished product without a sintering defect ( JP '648, para 0099).

With respect to (4), the process of sintering is caused by discharge plasma. Examiner interprets that the process of treating the knead-dispersed material by discharge plasma is equivalent to sintering the knead-dispersed material. Process of sintering the resultant dispersed material by discharge plasma is the extension sintering of the knead-dispersed material.

Combining (1), (2), (3) and (4), at the time of invention it would have been obvious to a person of ordinary skill to synthesize the carbon nanotube composite material (JP '256 teaching) utilizing process of sintering by discharge plasma (JP '648 teaching) by dispersing the solids in a wet stage using a surfactant (Reddy teaching) and treating the carbon nanotube by plasma discharge (Jung teaching). The suggestion or motivation for doing so would have been to make a homogeneous liquid dispersion

with surfactant that would lead to a homogeneous green body which would lead to compact body that has low defects. A combination of surfactant and wet medium allows enhanced mobility of nanosize particles while plasma treatment of carbon nanotube alters the surface electrical properties of carbon nanotubes so that end composite material containing the carbon nanotubes have a range of electrical properties. Discharge plasma sintering of a green body produces homogeneous finished product without a sintering defect ( JP '648, para 0099).

### ***Summary***

The **claims 1-12** are rejected.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BIJAY SAHA whose telephone number is (571)270-5781. The examiner can normally be reached on Monday- Friday 8:00 a.m. EST - 5:00 p.m. EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vickie Kim can be reached on 571 272 0579. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BIJAY SAHA/  
Examiner, Art Unit 4181

/MICHAEL MARCHESCI/  
Primary Examiner, Art Unit 1793